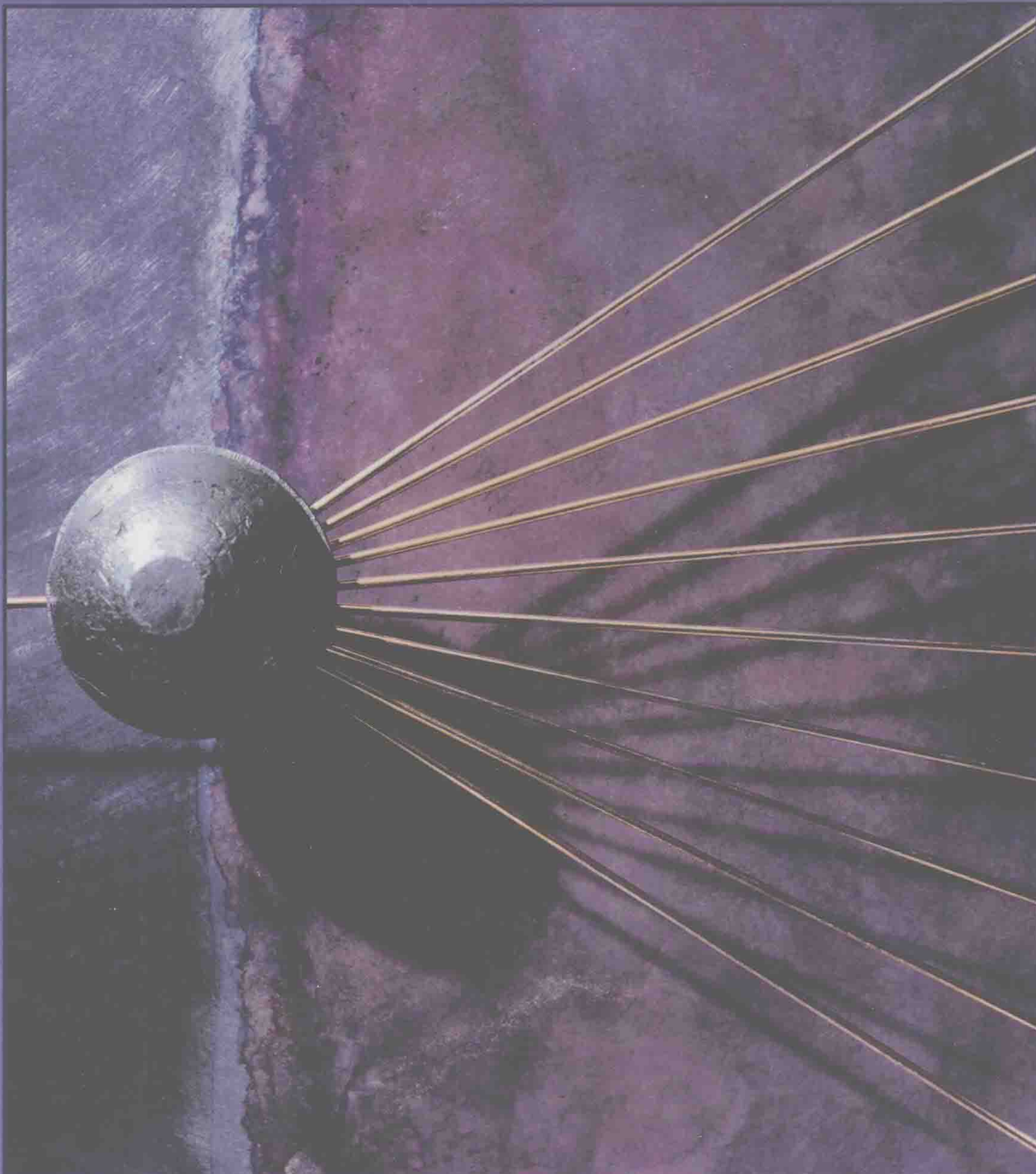
ANNOTATED INSTRUCTOR'S EDITION

Intermediate Algebra

SIXTH EDITION



Gustafson • Frisk

Intermediate Algebra

SIXTH EDITION

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Preface

To the Instructor

Intermediate Algebra, Sixth Edition, is the second of a two-volume series designed to prepare students for college mathematics. It presents all of the topics associated with a second course in algebra. We believe that it will hold student attrition to a minimum, while preparing students to succeed—whether in college algebra, trigonometry, statistics, finite mathematics, liberal arts mathematics, or everyday life.

Our goal has been to write a book that

- is enjoyable to read,
- is easy to understand,
- is relevant, and
- develops the necessary skills for success in future academic courses or on the job.

The Sixth Edition retains the basic philosophy of the highly successful previous editions. The revisions include several improvements in line with the NCTM standards, the AMATYC Crossroads, and the current trends in mathematics reform. For example, emphasis continues to be placed on graphing and problem solving.

GENERAL CHANGES IN THE SIXTH EDITION

In the sixth edition, the following general improvements have been made.

- *We have improved the visual interest of the book by using a new design.* Color is used not just as a design feature, but to highlight terms that instructors would point to in a classroom discussion.
- *The answers to the Self Check problems are placed at the end of each section.* Now students will not be tempted to look at the answer before working the problem.
- The Warnings feature is now replaced with a more positive Comments feature. The Comments continue to warn students of common errors, but they also reinforce concepts and extend ideas presented in the text.
- *We have improved the set of text-specific videotapes.* Video symbols in the text mark the examples taught on tape. Selected exercises are also taught on tape.

1.5 Solving Equations

■ Equations ■ Properties of Equality ■ Solving Linear Equations
■ Combining Like Terms ■ Identities and Contradictions ■ Formulas

Getting Ready *Fill the blanks to make a true statement.*

1. $+ 3 = 5$ **2.** $8 - \quad = 4$ **3.** $\frac{12}{\quad} = 4$ **4.** $\cdot 5 = 30$

■ EQUATIONS

An **equation** is statement indicating that two quantities are equal. The equation $2 + 4 = 6$ is true, and the equation $2 + 4 = 7$ is false. If an equation has a variable (say, x) it can be either true or false, depending on the value of x. For example, if $x = 1$, the equation $7x - 3 = 4$ is true.

$$7(1) - 3 = 4 \quad \text{Substitute 1 for } x.$$
$$7 - 3 = 4$$
$$4 = 4$$

However, the equation is false for all other values of x. Since 1 makes the equation true, we say that 1 *satisfies* the equation.

The set of numbers
ments of the solution s
solution set of an equati

Example 1 Determine whether 3 is

Solution We substitute 3 for x an

$$2x + 4 = 10$$
$$2(3) + 4 \stackrel{?}{=} 10$$
$$6 + 4 \stackrel{?}{=} 10$$
$$10 = 10$$

Since $10 = 10$, the num

Self Check Is -5 a solution of $2x$

◀ The simple design makes reading easy.

Definitions are clearly marked in boxes. ▼

■ EXPONENTS

Exponents indicate repeated multiplication. For example,

$y^2 = y \cdot y$ Read y^2 as "y to the second power" or "y squared."
$z^3 = z \cdot z \cdot z$ Read z^3 as "z to the third power" or "z cubed."
$x^4 = x \cdot x \cdot x \cdot x$ Read x^4 as "x to the fourth power."

These examples suggest the following definition.

Natural-Number Exponents

> If n is a natural number, then
> $$x^n = \overbrace{x \cdot x \cdot x \cdot \cdots \cdot x}^{n \text{ factors of } x}$$

The exponential expression x^n is called a **power of x**, and we read it as "x to the nth power." In this expression, x is called the **base**, and n is called the **exponent**.

$$\text{Base} \longrightarrow x^n \longleftarrow \text{Exponent}$$

A natural-number exponent tells how many times the base of an exponential expression is to be used as a factor in a product.

Examples that are worked on tape are marked with a video icon. ▶

Example 1 Write each number without using exponents.

a. $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

b. $(-2)^5 = (-2)(-2)(-2)(-2)(-2) = -32$

c. $-4^4 = -(4^4) = -(4 \cdot 4 \cdot 4 \cdot 4) = -256$

d. $(-4)^4 = (-4)(-4)(-4)(-4) = 256$

e. $\left(\frac{1}{2}a\right)^3 = \left(\frac{1}{2}a\right)\left(\frac{1}{2}a\right)\left(\frac{1}{2}a\right) = \frac{1}{8}a^3$

f. $\left(-\frac{1}{5}b\right)^2 = \left(-\frac{1}{5}b\right)\left(-\frac{1}{5}b\right) = \frac{1}{25}b^2$

Self Checks follow most examples. ▶

Self Check Write each number without using exponents: **a.** 3^4, **b.** $(-5)^3$, and **c.** $\left(-\frac{3}{4}a\right)^2$. ■

Comments reinforce ideas and warn students about common errors. ▶

COMMENT Note the difference between $-x^n$ and $(-x)^n$.

$$-x^n = -(\overbrace{x \cdot x \cdot x \cdot \cdots \cdot x}^{n \text{ factors of } x}) \quad \text{and} \quad (-x)^n = \overbrace{(-x)(-x)(-x) \cdot \cdots \cdot (-x)}^{n \text{ factors of } -x}$$

Also, note the difference between ax^n and $(ax)^n$

$$ax^n = a \cdot \overbrace{x \cdot x \cdot x \cdot \cdots \cdot x}^{n \text{ factors of } x} \quad \text{and} \quad (ax)^n = \overbrace{(ax)(ax)(ax) \cdot \cdots \cdot (ax)}^{n \text{ factors of } -ax}$$

■ PROPERTIES OF EXPONENTS

Since x^5 means that x is to be used as a factor fives times, and since x^3 means that x to be used as a factor three times, $x^5 \cdot x^3$ means that x will be used as a factor eight times.

- *The test question bank has been improved* and adapted to a new computerized testing system.
- *We have fine-tuned the presentation of many topics* for better flow of ideas and for clarity.

SPECIFIC CHANGES IN THE SIXTH EDITION

Specific changes made in the chapters are as follows.

Chapter 1 presents a review of basic topics. More applications have been added to several sections. To solve problems, the book continues to use a problem-solving technique consisting of the following steps:

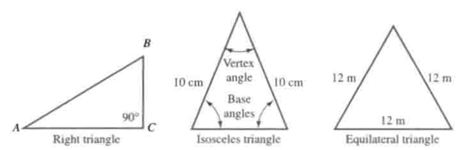
1. Analyze the problem.
2. Form an equation.
3. Solve the equation.
4. State the conclusion.
5. Check the result.

Geometry is emphasized throughout the book. ►

A special icon indicates which examples are on the interactive CD. ►

Problem solving involves a five-step strategy. ►

A **right triangle** is a triangle with one right angle. In Figure 1-27(a), $\angle C$ (read as "angle C") is a right angle. An **isosceles triangle** is a triangle with two sides of equal measure that meet to form the **vertex angle.** The angles opposite the equal sides, called the **base angles,** are also equal. An **equilateral triangle** is a triangle with three equal sides and three equal angles.



(a) (b) (c)

Figure 1-27

Example 4 **Angles in a triangle** If the vertex angle of the isosceles triangle shown in Figure 1-27(b) measures 64°, find the measure of each base angle.

Analyze the problem We are given that the vertex angle measures 64°. If we let $x°$ represent the measure of one base angle, the measure of the other base angle is also $x°$. Thus, the sum of the angles in the triangle is $x° + x° + 64°$. Because the sum of the measures of the angles of any triangle is 180°, we know that $x° + x° + 64°$ is equal to 180°.

From an equation We can form the equation

The measure of one base angle	plus	the measure of the other base angle	plus	the measure of the vertex angle	equals	180°
x	+	x	+	64	=	180

Solve the equation We now solve the equation.

$$x + x + 64 = 180$$
$$2x + 64 = 180 \quad \text{Combine like terms.}$$
$$2x = 116 \quad \text{Subtract 64 from both sides.}$$
$$x = 58 \quad \text{Divide both sides by 2.}$$

State the conclusion The measure of each base angle is 58°.

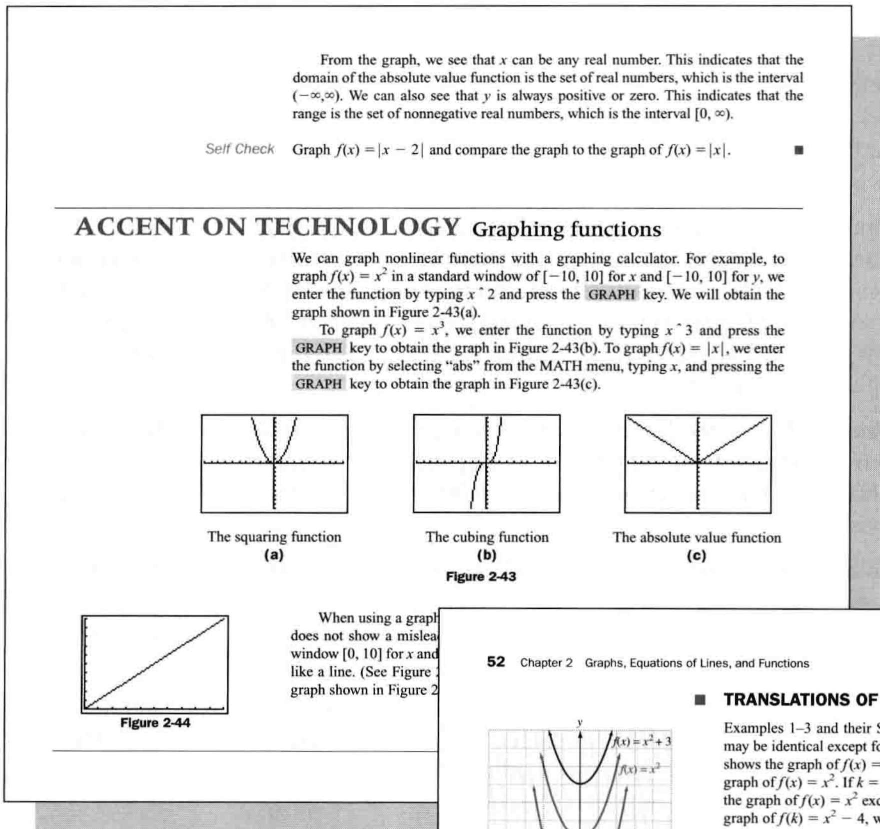
Check the result The sum of the measures of each base angle and the vertex angle is 180°:

$$58° + 58° + 64° = 180°$$

■

Chapter 2 covers graphs, equations of lines, and functions. The first section now includes an introduction to the rectangular coordinate system and graphing linear equations. In this section, we emphasize the relationships between equations, tables, and graphs. Graphing calculators are introduced in a special graphing calculator feature. Slopes of lines are first presented as rates of change, with many applications included.

Linear functions and function notation are introduced in Section 2.4. Squaring functions, cubing functions, and absolute value functions are covered in Section 2.5, where we begin to develop the concept of translations of functions.



From the graph, we see that x can be any real number. This indicates that the domain of the absolute value function is the set of real numbers, which is the interval $(-\infty, \infty)$. We can also see that y is always positive or zero. This indicates that the range is the set of nonnegative real numbers, which is the interval $[0, \infty)$.

Self Check Graph $f(x) = |x - 2|$ and compare the graph to the graph of $f(x) = |x|$. ■

ACCENT ON TECHNOLOGY Graphing functions

We can graph nonlinear functions with a graphing calculator. For example, to graph $f(x) = x^2$ in a standard window of $[-10, 10]$ for x and $[-10, 10]$ for y, we enter the function by typing x ^ 2 and press the GRAPH key. We will obtain the graph shown in Figure 2-43(a).

To graph $f(x) = x^3$, we enter the function by typing x ^ 3 and press the GRAPH key to obtain the graph in Figure 2-43(b). To graph $f(x) = |x|$, we enter the function by selecting "abs" from the MATH menu, typing x, and pressing the GRAPH key to obtain the graph in Figure 2-43(c).

The squaring function (a) | The cubing function (b) | The absolute value function (c)

Figure 2-43

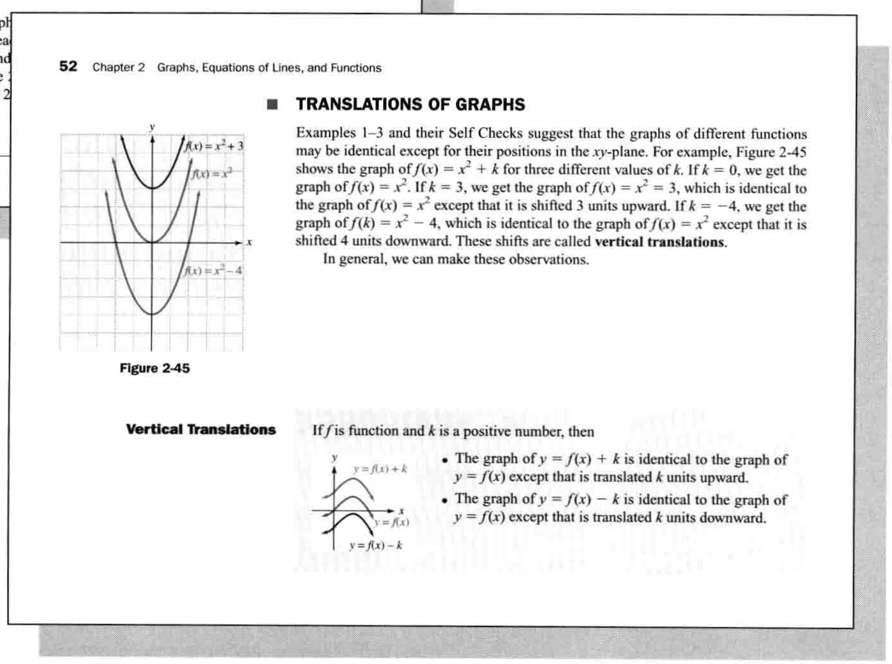
When using a graph... does not show a mislea... window [0, 10] for x and... like a line. (See Figure ... graph shown in Figure 2...

Figure 2-44

◀ Graphing calculator material appears in Accent on Technology features.

◀ Functions are classified into families.

Translations of graphs are covered early and revisited throughout the book. ▼



52 Chapter 2 Graphs, Equations of Lines, and Functions

■ **TRANSLATIONS OF GRAPHS**

Figure 2-45

Examples 1–3 and their Self Checks suggest that the graphs of different functions may be identical except for their positions in the xy-plane. For example, Figure 2-45 shows the graph of $f(x) = x^2 + k$ for three different values of k. If $k = 0$, we get the graph of $f(x) = x^2$. If $k = 3$, we get the graph of $f(x) = x^2 = 3$, which is identical to the graph of $f(x) = x^2$ except that it is shifted 3 units upward. If $k = -4$, we get the graph of $f(k) = x^2 - 4$, which is identical to the graph of $f(x) = x^2$ except that it is shifted 4 units downward. These shifts are called **vertical translations.**

In general, we can make these observations.

Vertical Translations If f is function and k is a positive number, then

- The graph of $y = f(x) + k$ is identical to the graph of $y = f(x)$ except that is translated k units upward.
- The graph of $y = f(x) - k$ is identical to the graph of $y = f(x)$ except that is translated k units downward.

Chapter 3 presents systems of equations. Systems are solved by graphing, elimination, matrix, and determinant methods. We have added several more application problems.

Chapter 4 covers linear inequalities, systems of linear inequalities, and linear programming. The section on linear programming has been rewritten to make it easier for students to read. Again, many application problems are included.

Chapter 5 covers polynomials, polynomial functions, and factoring. The introduction to polynomial functions has been improved, and more applications have been added throughout the chapter.

Factoring is discussed in Sections 5.4–5.8. All of the traditional topics associated with factoring are included.

Chapter 6 covers rational expressions, beginning with a discussion of simple rational functions, including applications. Section 6.2 covers proportion and variation, including work on similar triangles. Direct variation is related to linear functions, and inverse variation is related to rational functions. Sections 6.3–6.5 cover the standard work on the arithmetic of rational expressions. The chapter contains only minor revisions.

Chapter 7 presents rational exponents and radicals. The square-root and cube-root functions and their translations are introduced in Section 7.1. The Pythagorean theorem and other applications of radicals are discussed in Section 7.2. The work on equations containing radicals has been moved to Section 7.6. Rational exponents are now discussed in Section 7.3. Sections 7.4–7.5 cover the traditional material on manipulation of radical expressions.

Chapter 8 covers quadratic functions, inequalities, and algebra of functions. This chapter builds on the concepts of graphs of functions and their translations, but is otherwise a fairly standard treatment of the topics. This chapter contains only minor revisions.

Chapter 9 introduces exponential and logarithmic functions. Their graphs and translations of their graphs are thoroughly discussed, as are base-e exponential and base-e logarithmic functions. This chapter includes a wealth of applications. It has been revised only slightly.

Chapter 10 covers conic sections, piecewise-defined functions, and step functions. The work includes both conics centered at the origin and conics centered at (h, k). Completing the square is used to write equations of conics in standard form. This chapter contains only minor revisions.

Chapter 11 includes a standard treatment of the binomial theorem, sequences, and permutations and combinations. It retains the previous edition's presentation of the material.

FEATURES OF THE SIXTH EDITION

Important features of the sixth edition are as follows.

- *Over 500 well-written examples* show students how to work problems. Most examples include extensive author notes explaining the steps used in the problem-solving process. Color is used to highlight terms that instructors would point to in a classroom discussion.
- *Self Checks* accompany most examples, providing instant student feedback. The answers to the Self Check problems appear at the end of each section.

- *Comprehensive exercises sets* contain Review, Vocabulary and Concepts, Practice, Applications, Writing, and Something to Think About problems.
- *Problem solving is emphasized through realistic applications.* The number and variety of application problems has been increased. All application problems have special titles.

All exercise sets begin with Review exercises. ▶

EXERCISE 1.4

REVIEW *Write each fraction as a terminating or a repeating decimal.*

1. $\frac{3}{4}$
2. $\frac{4}{5}$
5. A man raises 3 to the second power, 4 to the third power, and 2 to the fourth power and then finds their sum. What number does the he obtain?
6. If $a = -2$, $b = -3$, and $c = 4$, find the value of

Vocabulary and Concepts problems help the student read the book. ▶

Practice problems provide drill. ▶

Most exercise sets provide numerous application problems. ▶

VOCABULARY AND CONCEPTS *Fill in the blanks.*

7. A number is written in scientific notation when it is written in the form N × ____, where $1 \le |N| < 10$ and n is an integer.
8. To change 6.31×10^4 to standard notation, we move the decimal point in 6.31 ____ places to the right.
9. To change 6.31×10^{-4} to standard notation, we move the decimal point four places to the ____.
10. The number 6.7×10^3 ____ (> or <) the number $6{,}700{,}000 \times 10^{-4}$.

PRACTICE *Write each numeral in scientific notation.*

11. 3,900
12. 1,700
13. 0.0078
14. 0.068
15. −45,000
16. −547,000
17. −0.00021
18. −0.00078
19. 17,600,000
20. 89,800,000
21. 0.0000096
22. 0.000046
23. 323×10^5
24. 689×10^9
25. $6{,}000 \times 10^{-7}$
26. 765×10^{-5}
27. 0.0527×10^5
28. 0.0298×10^3
29. 0.0317×10^{-2}
30. 0.0012×10^{-3}

Write each numeral in standard notation.

31. 2.7×10^2
32. 7.2×10^3
33. 3.23×10^{-3}
34. 6.48×10^{-2}

45. $\frac{(640{,}000)(2{,}700{,}000)}{120{,}000}$
46. $\frac{(0.0000013)(0.000090)}{0.00039}$

Write each numeral in scientific notation and to the operations. Give all answer in standard notation.

47. $\frac{(0.006)(0.008)}{0.0012}$
48. $\frac{(600)(80{,}000)}{120{,}000}$
49. $\frac{(220{,}000)(0.000009)}{0.00033}$
50. $\frac{(0.00024)(96{,}000{,}000)}{640{,}000{,}000}$
51. $\frac{(320{,}000)^2(0.0009)}{12{,}000^2}$
52. $\frac{(0.000012)^2(49{,}000)^2}{0.021}$

Use a scientific calculator to evaluate each expression. Round each answer to the appropriate number of significant digits.

53. $23{,}437^3$
54. 0.00034^4
55. (63,480)(893,322)
56. $(0.0000413)(0.0000049)^2$
57. $\frac{(69.4)^8(73.1)^2}{(0.0043)^3}$
58. $\frac{(0.0031)^4(0.0012)^5}{(0.0456)^{-7}}$

APPLICATIONS *Use scientific notation to find each answer. Round all answers to the proper number of significant digits.*

59. **Wavelengths** Transmitters, vacuum tubes, and lights emit energy that can be modeled as a wave. List the wavelengths shown in Illustration 1 in order, from shortest to longest.

All exercise sets conclude with Writing and Something to Think About problems. ▶

All application problems have titles. ▶

ILLUSTRATION 3

68. **Distance to the moon** The moon is about 378,196 kilometers from Earth. Express this distance in inches. (*Hint:* 1 km ≈ 0.6214 mile.)
69. **Angstroms per inch** One **angstrom** is 0.0000001 millimeter, and one inch is 25.4 millimeters. Find the number of angstroms in one inch.

WRITING

75. Explain how to change a number from standard notation to scientific notation.
76. Explain how to change a number from scientific notation to standard notation.

SOMETHING TO THINK ABOUT

77. Find the highest power of 2 that can be evaluated with a scientific calculator.
78. Find the highest power of 7 that can be evaluated with a scientific calculator.

- *Realistic applications* appear throughout the text. In addition to numerous applications in the exercise sets, each chapter begins with a Mathematics in the Workplace feature, which provides an application that must be solved on the job.
- *Getting Ready exercises,* appearing at the beginning of each section, review the ideas that will be needed in the section.
- *Oral exercises,* appearing at the end of each section, enable instructors to check student understanding before the students leave class.

Mathematics in the Workplace

Electrical/electronic engineer Electrical engineers design, develop, test, and supervise the manufacture of electronic equipment. Electrical engineers who work with electronic equipment are often called **electronic engineers.**

Sample Application In a radio, an inductor and a capacitor are used in a resonant circuit to select a wanted radio station at a frequency f and reject all others. The inductance L and the capacitance C determine the inductance reactance X_L and the capacitive reactance X_C of that circuit, where

$$X_L = 2\pi fL \quad \text{and} \quad X_C = \frac{1}{2\pi fC}$$

The radio station selected will be at the frequency f, where $X_L = X_C$. Write a formula for f^2 in terms of L and C.

(See Exercise 87 in Exercise 3.2.)

◀ Each chapter begins with a Mathematics in the Workplace application.

We have considered linear equations with the variables x and y. We found that each equation had infinitely many solutions (x, y), and that we could graph each equation on the rectangular coordinate system. In this chapter, we will discuss many **systems of linear equations** involving two or three equations.

Self Check answers appear before the Oral exercises.

3.1 Solution by G

- The Graphing Meth
- Dependent Equatio

Getting Ready *Let $y = -3x + 2$.*

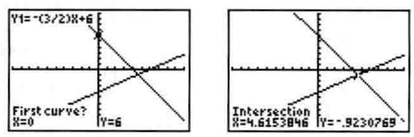
1. Find y when $x = 0$.
3. Find y when $x = -3$
5. Find five pairs of nu
6. Find five pairs of nu

THE GRAPHING M

In the pair of equations

$$\begin{cases} x + 2y = 4 \\ 2x - y = 3 \end{cases} \quad \text{(c}$$

there are infinitely man nitely many ordered pai only one ordered pair $(x,$ of finding this ordered p



(a) (b)

Figure 3-6

Verify that the exact solution is $x = \frac{60}{13}$ and $y = -\frac{12}{13}$.

Self Check Answers

1. (1, 2) **2.** no solutions **3.** infinitely many solutions; three of them are $(0, -4)$, $(2, 0)$, and $(-3, -10)$ **4.** (2, 3)

Orals *Tell whether the following systems will have one solution, no solutions, or infinitely many solutions.*

1. $\begin{cases} y = 2x \\ y = 2x + 5 \end{cases}$
2. $\begin{cases} y = 2x \\ y = x + x \end{cases}$
3. $\begin{cases} y = 2x \\ y = -2x \end{cases}$
4. $\begin{cases} y = 2x + 1 \\ 2x = y \end{cases}$

EXERCISE 3.1

REVIEW *Write each number in scientific notation.*

1. 93,000,000
2. 0.0000000236
3. 345×10^2
4. 752×10^{-5}
7. If a system has no solutions, it is called an ________ system.
8. If two equations have different graphs, they are called ________ equations.

▲ Each section begins with Getting Ready problems and ends with Oral exercises.

- *The emphasis is on learning mathematics through graphing.* Although graphing calculators are discussed frequently, their use is not mandatory. All of the topics are discussed in traditional ways.
- *We present comprehensive geometry content,* to integrate the subjects of algebra and geometry.
- *Topics from statistics* are introduced as applications of algebra, to provide background for students who will encounter these ideas in the future.

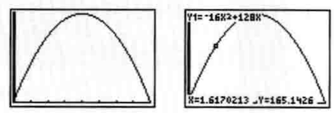
Students learn mathematics through graphing. ▶

8 Chapter 5 Polynomials and Polynomial Functions

ACCENT ON TECHNOLOGY: Graphing polynomial functions

We can graph polynomial functions with a graphing calculator. For example, to graph $y = P(t) = -16t^2 + 128t$, we can use window settings of [0, 8] for x and [0, 260] for y to get the parabola shown in Figure 5-4(a).

We can trace to estimate the height of the rocket for any number of seconds into the flight. Figure 5-4(b) shows that the height of the rock the flight is approximately 165 feet.



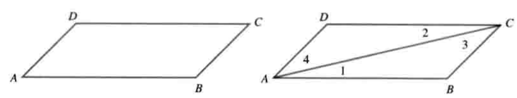
(a) (b)

Topics from geometry are emphasized throughout the book. ▶

■ **PARALLELOGRAMS**

A **parallelogram** is a four-sided figure with its opposite sides parallel. (See Figure 3-8(a).) Here are some important facts about parallelograms.

1. Opposite sides of a parallelogram have the same length.
2. Opposite angles of a parallelogram have the same measure.
3. Consecutive angles of a parallelogram are supplementary.
4. A diagonal of a parallelogram (see Figure 3-8(b)) divides the parallelogram into two *congruent triangles*—triangles with the same shape and same area.
5. In Figure 3-8(b), $\angle 1$ and $\angle 2$, and $\angle 3$ and $\angle 4$, are called pairs of *alternate interior angles*. When a diagonal intersects two parallel sides of a parallelogram, all pairs of alternate interior angles have the same measure.



(a) (b)

Topics from statistics are used as applications of algebra. ▶

■ **FINDING A SAMPLE SIZE**

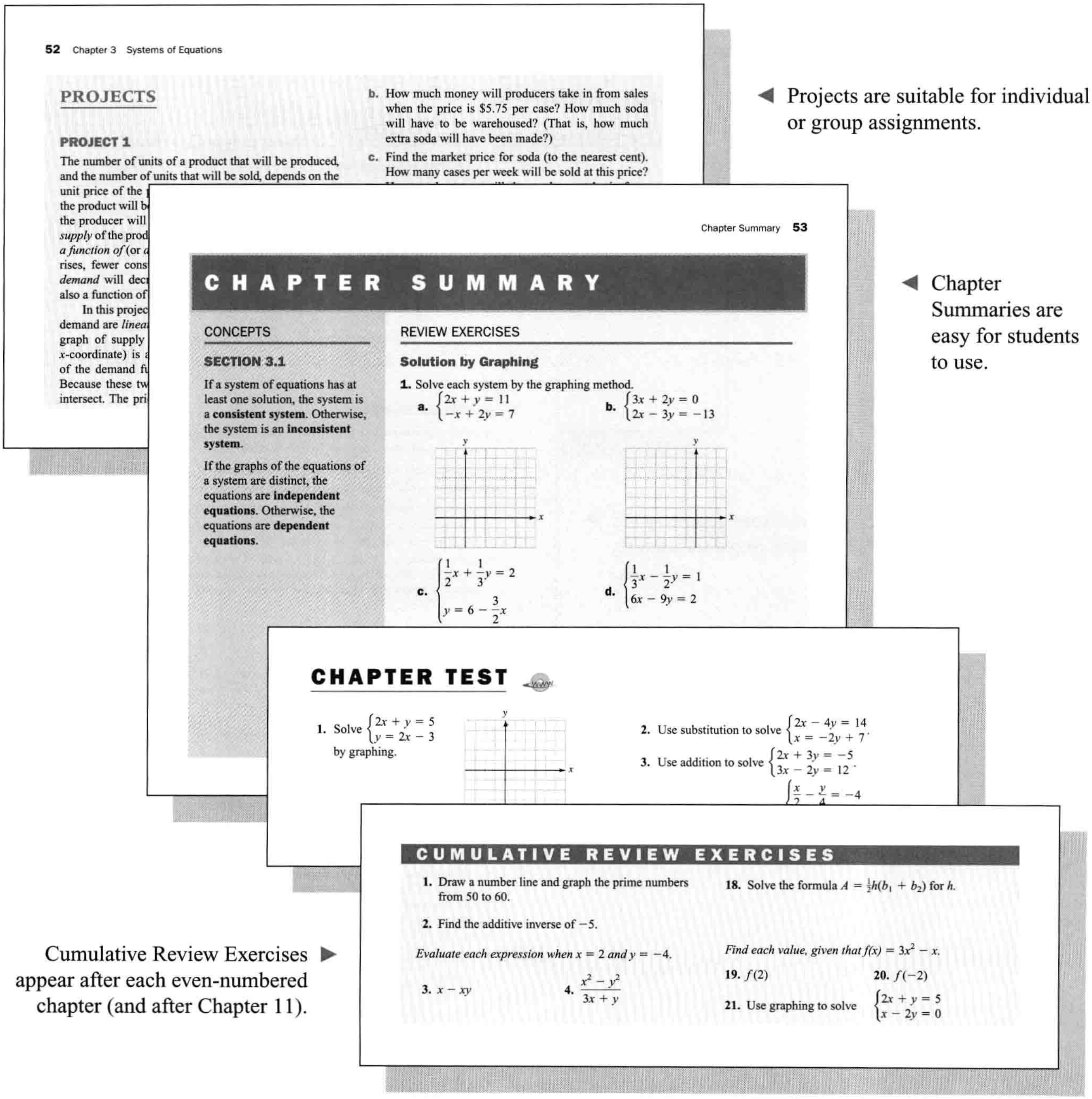
In statistics, researchers often estimate the mean of a population from the results of a random sample taken from the population.

Example 8 A researcher wants to estimate the mean (average) real estate tax paid by homeowners living in Rockford, IL. To do so, he decides to select a *random sample* of homeowners and compute the mean tax paid by the homeowners in that sample. How large must the sample be for the researcher to be 95% certain that his computed sample mean will be within \$35 of the true population mean—that is, within \$35 of the mean tax paid by all homeowners in the city? Assume that the standard deviation σ of all tax bills in the city is \$120.

Solution From elementary statistics, the researcher has the formula

$$\frac{3.84\sigma^2}{N} < E^2$$

- *Student projects* near the end of each chapter to give students an opportunity for group work or extended projects.
- *Chapter Summaries* are laid out to make a thorough review of each chapter easier for the student.
- *Chapter Tests* follow each Chapter Summary.
- *Cumulative Review Exercises* appear after Chapters 2, 4, 6, 8, 10, and 11.
- *A sample final examination* is included in Appendix II to help students practice for their final examination.


52 Chapter 3 Systems of Equations

PROJECTS

PROJECT 1

The number of units of a product that will be produced, and the number of units that will be sold, depends on the unit price of the

b. How much money will producers take in from sales when the price is \$5.75 per case? How much soda will have to be warehoused? (That is, how much extra soda will have been made?)

c. Find the market price for soda (to the nearest cent). How many cases per week will be sold at this price?

Chapter Summary 53

CHAPTER SUMMARY

CONCEPTS

SECTION 3.1

If a system of equations has at least one solution, the system is a **consistent system**. Otherwise, the system is an **inconsistent system**.

If the graphs of the equations of a system are distinct, the equations are **independent equations**. Otherwise, the equations are **dependent equations**.

REVIEW EXERCISES

Solution by Graphing

1. Solve each system by the graphing method.

a. $\begin{cases} 2x + y = 11 \\ -x + 2y = 7 \end{cases}$ b. $\begin{cases} 3x + 2y = 0 \\ 2x - 3y = -13 \end{cases}$

c. $\begin{cases} \frac{1}{2}x + \frac{1}{3}y = 2 \\ y = 6 - \frac{3}{2}x \end{cases}$ d. $\begin{cases} \frac{1}{3}x - \frac{1}{2}y = 1 \\ 6x - 9y = 2 \end{cases}$

CHAPTER TEST

1. Solve $\begin{cases} 2x + y = 5 \\ y = 2x - 3 \end{cases}$ by graphing.

2. Use substitution to solve $\begin{cases} 2x - 4y = 14 \\ x = -2y + 7 \end{cases}$.

3. Use addition to solve $\begin{cases} 2x + 3y = -5 \\ 3x - 2y = 12 \end{cases}$.

CUMULATIVE REVIEW EXERCISES

1. Draw a number line and graph the prime numbers from 50 to 60.

2. Find the additive inverse of -5.

Evaluate each expression when $x = 2$ and $y = -4$.

3. $x - xy$

4. $\frac{x^2 - y^2}{3x + y}$

18. Solve the formula $A = \frac{1}{2}h(b_1 + b_2)$ for h.

Find each value, given that $f(x) = 3x^2 - x$.

19. $f(2)$

20. $f(-2)$

21. Use graphing to solve $\begin{cases} 2x + y = 5 \\ x - 2y = 0 \end{cases}$

◀ Projects are suitable for individual or group assignments.

◀ Chapter Summaries are easy for students to use.

Cumulative Review Exercises ▶ appear after each even-numbered chapter (and after Chapter 11).

CALCULATORS

The use of scientific and graphing calculators is assumed throughout the book. We believe that students should learn calculator skills in the mathematics classroom. They will then be prepared to use calculators in science and business classes and for nonacademic purposes. The directions within each exercise set indicate which exercises require calculators.

The use of calculators is recommended but optional. ▶

Example 8 Find the midpoint of the line segment joining $P(-2, 3)$ and $Q(3, -5)$.

Solution To find the midpoint, we find the mean of the x-coordinates and the mean of the y-coordinates to get

$$\frac{x_1 + x_2}{2} = \frac{-2 + 3}{2} = \frac{1}{2} \quad \text{and} \quad \frac{y_1 + y_2}{2} = \frac{3 + (-5)}{2} = -1$$

The midpoint of segment PQ is the point $M(\frac{1}{2}, -1)$.

Self Check Find the midpoint of the segment joining $P(5, -4)$ and $Q(-3, 5)$. ■

ACCENT ON TECHNOLOGY Graphing lines

FIGURE 2-12 TI-83 graphing calculator (Courtesy of Texas Instruments)

We have graphed linear equations by finding ordered pairs, plotting points, and drawing a line through those points. Graphing is much easier if we use a graphing calculator.

Graphing calculators have a window to display graphs (see Figure 2-12). To see the proper picture of a graph, we must decide on the minimum and maximum values for the x- and y-coordinates. A window with standard settings of

$$\text{Xmin} = -10 \quad \text{Xmax} = 10 \quad \text{Ymin} = -10 \quad \text{Ymax} = 10$$

will produce a graph where the value of x is in the interval $[-10, 10]$ and y is in the interval $[-10, 10]$.

To graph $3x + 2y = 12$, we must first solve the equation for y.

$$3x + 2y = 12$$
$$2y = -3x + 12 \quad \text{Subtract } 3x \text{ from both sides.}$$
$$y = -\frac{3}{2}x + 6 \quad \text{Divide both sides by 2.}$$

To graph the equation, we enter the right-hand side of the equation after a symbol like $\backslash Y_1 =$ or $f(x) =$. After entering the right-hand side, the display should look like

$$\backslash Y_1 = -(3/2)X + 6 \quad \text{or} \quad f(x) = -(3/2)X + 6$$

We then press the GRAPH key to get the graph shown in Figure 2-13(a). To show more detail, we can draw the graph in a different window. A window with settings of $[-1, 5]$ for x and $[-2, 7]$ for y will give the graph shown in Figure 2-13(b).

ANCILLARIES FOR THE INSTRUCTOR

Annotated Instructor's Edition This special version of the complete student text has answers printed in blue next to the respective exercises.

Test Bank The test bank includes 8 tests per chapter as well as 3 final exams. The tests are made up of a combination of multiple-choice, free-response, true/false, and fill-in-the-blank questions.

Complete Solutions Manual The *Complete Solutions Manual* provides worked-out solutions to all problems in the text.

Brooks/Cole Assessment *Brooks/Cole Assessment* is a text-specific, Internet-ready testing suite that allows instructors to customize exams and track student progress in an accessible, browser-based format. BCA offers full algorithmic generation of problems and free-response mathematics. The complete integration of the testing and course-management components simplifies routine tasks. Test results flow automatically to the gradebook, and the instructor can easily communicate with individuals, sections, or entire courses.

Text-Specific Videotapes This set of videotapes is available free upon adoption of the text. Each tape covers one chapter of the text, broken into problem-solving sessions of 10 to 20 minutes. Examples that are taught on tape are identified by this logo.

ANCILLARIES FOR THE STUDENT

Student Solutions Manual The *Student Solutions Manual* provides worked-out solutions to the odd-numbered problems in the text.

BCA Tutorial This text-specific, interactive tutorial software is delivered via the Web (at http://bca.brookscole.com) and is offered in both student and instructor versions. Like *Brooks/Cole Assessment,* it is browser-based, which makes it an intuitive mathematical guide even for students with little technological proficiency. *BCA Tutorial* allows students to work with real math notation in real time and provides instant analysis and feedback. The tracking program built into the instructor version of the software enables instructors to monitor student progress with ease.

Interactive Video Skillbuilder CD Packaged with each book, this single CD-ROM contains more than eight hours of video instruction. There is at least one video lesson for each section of the book. The problems worked during each video lesson are listed next to the viewing screen so that students can work them ahead of time if they choose. In order to help students evaluate their progress, each section contains a 10-question Web quiz, and each chapter contains a chapter test. Answers are provided for each problem of each test.

To the Student

Congratulations. You now own a state-of-the-art textbook that has been written especially for you. We have tried to write a book that you can read and understand. The text includes carefully written narrative and an extensive number of worked examples with Self Checks.

To get the most out of this course, you must read and study the textbook properly. We recommend that you work the examples on paper first and then do the Self Checks. Only after you thoroughly understand the concepts taught in the examples should you attempt to work the exercises. A *Student Solutions Manual* contains the solutions to the odd-numbered exercises.

Since the material presented in *Intermediate Algebra,* Sixth Edition, will be of value to you in later years, we suggest that you keep this book. It will be a good source of reference and will keep at your fingertips the material that you have learned here.

We wish you well.

HINTS ON STUDYING ALGEBRA

The phrase "Practice makes perfect" is not quite true. It is *perfect* practice that makes perfect. For this reason, it is important that you learn how to study algebra to get the most out of this course.

Although we all learn differently, there are some hints on how to study algebra that most students find useful. Here are some things you should consider as you work on the material in this course.

Plan a Strategy for Success

To get where you want to be, you need a goal and a plan. Your goal should be to pass this course with a grade of A or B. To earn one of these grades, you must have a plan to achieve it. A good plan involves several points:

- Getting ready for class
- Attending class
- Doing homework
- Arranging for special help when you need it
- Having a strategy for taking tests

Getting Ready for Class

To get the most out of every class period, you will need to prepare for class. One of the best things you can do is to preview the material in the text that your instructor will be discussing. Perhaps you will not understand all of what you read, but you will understand it better when the instructor discusses the material in class.

Be sure to do your work every day. If you get behind and attend class without understanding previous material, you will be lost and will become frustrated and discouraged. Make a promise to prepare for class, and then keep that promise.

Attending Class

The classroom experience is your opportunity to learn from your instructor. Make the most of it by attending every class. Sit near the front of the room, where you can easily see and hear. It is easy to be distracted and lose interest if you sit in the back of the room. Remember that it is your responsibility to follow the discussion, even though that takes concentration and hard work.

Pay attention to your instructor, and jot down the important things that he or she says. However, do not spend so much time taking notes that you fail to concentrate on what your instructor is explaining. It is much better to listen and understand the big picture than just to copy solutions to problems.

Don't be afraid to ask questions when your instructor asks for them. If something is unclear to you, it is probably unclear to many other students as well. They will appreciate your willingness to ask. Besides, asking questions will make you an active participant in class. This will help you pay attention and keep you alert and involved.

Doing Homework

It requires practice to excel at tennis, master a musical instrument, or learn a foreign language. In the same way, it requires practice to learn mathematics. Since practice in mathematics is the homework, homework is your opportunity to practice your skills and experiment with ideas.

It is very important for you to pick a definite time to study and do homework. Set a formal schedule and stick to it. Try to study in a place that is comfortable and quiet. If you can, do some homework shortly after class, or at least before your forget what was discussed in class. This quick follow-up will help you remember the skills and concepts your instructor taught that day.

Each formal study session should include three parts:

1. Begin every study session with a review period. Look over previous chapters and see if you can do a few problems from previous sections, chosen randomly. Keeping old skills alive will greatly reduce the time you will need to prepare for tests.
2. After reviewing, read the assigned material. Resist the temptation of diving into the exercises without reading and understanding the examples. Instead, work the

examples and Self Checks with pencil and paper. Only after you completely understand the principles behind them should you try to work the exercises.

Once you begin to work the exercises, check your answers with those printed in the back of the book. If one of your answers differs from the printed answer, see if the two can be reconciled. Sometimes answers can have more than one form. If you decide that your answer is incorrect, compare your work to the example in the text that most closely resembles the exercise, and try to find your mistake. If you cannot find an error, consult the *Student Solutions Manual*. If nothing works, mark the problem and ask about it in your next class meeting.

3. After completing the written assignment, preview the next section. This preview will be helpful when you hear that material discussed during the next class period.

   You probably know the general rule of thumb for college homework: two hours of practice for every hour in class. If mathematics is hard for you, plan on spending even more time on homework.

   To make homework more enjoyable, study with one or more friends. The interaction will clarify ideas and help you remember them. If you must study alone, try talking to yourself. A good study technique is to explain the material to yourself out loud.

Arranging for Special Help

Take advantage of any special help that is available from your instructor. Often, the instructor can clear up difficulties in a very short time.

Find out whether your college has a free tutoring program. Peer tutors can often be of great help.

Taking Tests

Students often get nervous before a test, because they are afraid that they will not do well. To build confidence in your ability to work tests, rework many of the problems in the exercise sets, work the exercises in the Chapter Summaries, and take the Chapter Tests. Check all answers with those printed at the back of the text.

Then guess what the instructor will ask, build your own tests, and work them. Once you know your instructor, you will be surprised at how good you can get at picking test questions. With this preparation, you will have some idea of what will be on the test. You will have more confidence in your ability to do well. You will be far less nervous before tests, and this will also help your performance.

When you take a test, work slowly and deliberately. Scan the test and work the easy problems first. This will build confidence. Tackle the hardest problems last.

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